Appendix B: Technical Position Papers

LPDA-TPP-001

Absorption Corrections

R L Howes

7/6/95

Applicable FAR: FAR 36, Appendix G, G36.201(d)(1)

Applicable JAR: JAR 36, 4th Draft, Dec 1993, Section 1, Appendix 3, 5.2.2

1. Recommendation

Adopt the absorption correction procedures outlined in JAR referenced above.

2. Background and Relevant Data

Both the JAR and FAR referenced above require correction for atmospheric absorption if test conditions are outside the limits specified. JAR 36, Section 1, Appendix 3, 5.2.2 defines this as:

$$\Delta(M) = 0.01(H_T\alpha\text{-}0.2H_R) \quad (1)$$

FAR 36, Appendix G, G36.201(d)(1) defines this correction as:

$$\Delta(M) = (\alpha\text{-}0.7)\frac{H_T}{1000} \quad (2)$$

3. Discussion

These calculations are based on a reference temperature of 15 deg C in the JAR case and 25 deg C in the FAR case.

The FAR method shown in equation (2) is based on a reference absorption coefficient that corresponds to a temperature other than the FAR reference temperature of 25 deg C.

Recommendation is made to adopt the JAR calculation including the 15 deg C reference temperature.

References -

1. Aerospace Recommended Practice, ARP 866A, prepared by SAE Committee A-21, Aircraft Noise measurement, Revised 3-15-75.

2. Joint Aviation Requirements, JAR 36, 4th Draft, Dec 1993, Section 1, Appendix 3, 5.2.2.

3. Federal Aviation Requirements, FAR 36, Appendix G, G36.201(d)(1).

Aviation Rulemaking Advisory Committee
FAR/JAR Harmonization Working Group
Propeller-Driven Small Airplanes

LPDA-TPP-002
Temperature/Humidity Test Windows
R L Howes and R Wilson

10/11/95

Applicable FAR: FAR 36, Appendix G, G36.201(b) and fig G1.

Applicable JAR: JAR 36, 4th Draft, Dec 1993, Section 1, Appendix 3, 5.2.2(a) and Fig A.3-2.

1. Recommendation

Adopt the test limits of JAR 36 referenced above.

2. Background and Relevant Data

These sections specify the temperature limits outside of which corrections to the measured data must be made. FAR 36 lower limit is 36.5 deg F (2.5 deg C) and JAR 36 lower limit is 35.6 deg F (2 deg C). To harmonize this it is recommended that the JAR limit of 35.6 deg F (2 deg C) which is consistent with ICAO wording, be adopted. Note also that all other limits shown in FAR 36, Figure G1 are consistent with the corresponding JAR limits.

LPDA-TPP-003

Harmonization Between the Maximum Take-off Weight of ICAO Annex 16 and the Airworthiness Regulations for Small Propeller Driven Aircraft of the American FAR and European JAR 23

R Wilson

March 1995

This Paper was formatted to meet the requirements for submission to the ICAO Committee on Aviation Environmental Protection Technical Issues Sub-group (Aeroplanes) and is attached.

The Paper was approved by the ICAO CAEP Working Group 1 at its meeting in Bonn in June 1995.

It was proposed for adoption into ICAO Annex 16 at CAEP 3 in Montreal in December 1995.

The proposal was accepted by CAEP 3.

Aviation Rulemaking Advisory Committee
FAR/JAR Harmonization Working Group
Propeller-Driven Small Airplanes

LPDA-TPP-004
Power Adjustments
John F Bertolacci

August 8, 1995

Applicable FAR: FAR 36, Appendix G, G36.201(d)(4)

Measured sound levels in decibels must be corrected for engine power by algebraically adding an increment equal to-

$\text{Delta}(3) = 17 \log (P_r / P_t)$

Where P_r and P_t are the test and reference engine powers respectively.

Applicable JAR: JAR 36, 4th Draft, Dec 1993, Section 1, Appendix 3, 5.2.2(d)

Measured sound levels shall be adjusted for engine power by algebraically adding an increment equal to-

$\text{Delta}_3 = K_3 \log (P_r / P_t)$

Where P_r and P_t are the test and reference engine powers respectively obtained from the manifold pressure/torque gauges and engine rpm. The value of K_3 shall be determined from approved data from the test aeroplane. In the absence of flight test data and at the discretion of the Authority a value of $K_3 = 17$ may be used.

1. Recommendation

It is recommended that FAR 36, Appendix G, G36.201(d)(4) be revised as follows:

"Measured sound levels in decibels must be corrected for engine power by algebraically adding an increment equal to-

$\text{Delta}(3) = K_3 \log (P_r / P_t)$

Where P_r and P_t are the test and reference engine powers respectively obtained from the manifold pressure/torque gauges and engine rpm. The value of K_3 shall be determined from approved data from the test Airplane. In the absence of flight test data and at the discretion of the FAA a value of $K_3 = 17$ may be used."

2. Background and Relevant Data

The only technical difference between these two regulations is the power correction constant. The FAR regulation requires the use of 17 for this constant. The FAR regulation requires the use of 17 for this constant. This value was an average value derived from FAA tests on seven aircraft (Reference 1). The power correction constant from this data base had a variation from 1.5 to 39.3, and for the same aircraft the constant varied as much as 26.7 points (12.6 to 39.3). In another FAA report (Reference 2), the power correction factor derived from tests varied from -0.7 to 10.7 at the primary microphone site.

3. Discussion

Based on the wide variation of the test derived power correction factor on the eight aircraft tested, it is recommended that the JAR wording be adopted and the power correction constant be determined from approved data from the test aircraft but a value of 17 can be used at the discretion of the certification authority. This would also be more consistent with the way the Mach Number adjustment is determined.

References

1. FAA Report EE-83-1, "Noise Levels and Data Analyses for Small Prop-Driven Aircraft", dated August 1993

2. FAA Report EE-86-1, "Acoustic Flight of the Piper Lance", dated December 1986

Aviation Rulemaking Advisory Committee
FAR/JAR Harmonization Working Group
Propeller-Driven Small Airplanes

LPDA-TPP-005

Differences in the Measurement Height from Meteorological Data

R Wilson

18th August 1995

This Paper was formatted to meet the requirements for submission to CAEP3 in Montreal in December 1995.

The proposal was accepted by CAEP3.

LPDA-TPP-005
DIFFERENCES IN THE MEASUREMENT HEIGHT FOR METEOROLOGICAL DATA

(Author - R Wilson)

18th August 1995

APPLICABLE: ICAO Annex 16, Appendix 6 and JAR 36, 4th Draft, Dec 1993, Section 1, Appendix 3, 2.2.2.

RECOMMENDATIONS FOR HARMONIZATION

ICAO Annex 16 Appendix 6, 2.2.2 should be amended to reflect the flexibility of FAR 36, Appendix G, G36.101 (b)(6) by adopting the FAR 36 wording.

ICAO Annex 16 Appendix 6, 2.2.2 (b) would then read: "... below 2°C."

ICAO Annex 16 Appendix 6, 2.2.2 (c) would then read: "... above 9 Km/h (5 kt) using a 30s average."

ICAO Annex 16 Appendix 6, 2.2.2 (d) would then read: "... points specified by the Authority; and ..."

A new ICAO Annex 16 Appendix 6, 2.2.2 (e) would add: "The meteorological measurements must be made between 1.2 m and 10 m above ground level. If the measurement site is within 1 nm of an airport meteorological station, measurements from this station may be used."

JAR 36, 4th Draft, Dec 1993, Section 1, Appendix 3, 2.2.2 should be similarly amended.

BACKGROUND & RELEVANT DATA

As presently published, there is a difference in the permitted measurement heights for Meteorological Data as specified by FAR 36, Appendix G, G36.101 (b)(6) and ICAO Annex 16 Appendix 6, 2.2.2 (b) and (c). JAR 36, 4th Draft, Dec 1993, Section 1, Appendix 3, 2.2.2 (b) and (c) is identical to ICAO Annex 16. The FAR allows for measurement between: "... 4 ft (1.2 m) and 33 ft (10 m) above ground level...." ICAO Annex 16 specifies "... at 1.2 m above the ground..."

LPDA-TPP-006
Microphone Height and Noise Limits
R L Howes and R Wilson
10/11/95

Applicable FAR: FAR 36, Appendix G, G36.107(a) and G36.301(b)

Applicable JAR: JAR 36, 5th Draft, Sept 1995, Section 1, Sub Part D, JAR 36.330 and Appendix 3, 4.4.1

1. Recommendation

Adopt JAR wording for both microphone position and configuration and associated noise limits.

2. Discussion

Considerations of microphone location and configuration and resulting noise limits are inter-related. This issue is not new. Much study and discussion has gone on. Technical papers summarizing analysis and test results comparing the microphone locations and configurations have been carried out and documented. See references [1]-[8].

The technical facts are that a microphone inverted over a metal plate at ground level affords a measurement not affected by variable ground reflections interacting with source radiation, which is in contrast with the 1.2m location.

A review of the two configurations will show that the effect of reflections from the metal plate is consistent and increases the measured levels by about 3 dB(A) when compared with a 1.2m configuration. Tests carried out with the 1.2m configuration show that the interaction with ground reflections is not consistent.

In the majority of cases the data acquired and analyzed in the course of establishing compliance with subject regulations can be a valuable tool for determining the physics controlling the noise radiation in specific cases. As such it is often used to determine effective changes and modifications. Using a data set from a 1.2m microphone introduces inconsistency and error which compromises this. The data obtained using the ground plane configuration provides a more consistent and reliable data base.

Social pressure for increased stringency is mounting. The need to respond to this pressure cannot be ignored. Any effective response must be based on a good understanding of the physics of noise from light propeller driven aircraft. Time, economy and available technology will no doubt dictate an experimental approach characterised by small and progressive improvements. Therefore it is more important than ever to be able to acquire consistent and reliable data without using a separate test setup. With the differences that exist today among bodies of regulations most manufacturers make two sets of measurements. Some even repeat the testing using each microphone measurement configuration. This imposes economic burdens associated with two microphone setups and/or repeatability issues if the test is conducted twice.

It is recommended that the JAR wording be adopted. This will require an adjustment to the current FAR limit to account for the reflection effect discussed. Although this may appear in some circles as decreased stringency, it is not. In the long term it will enable a quicker, more economic response to stringency issues and will assist with source noise reduction studies.

References -

1. DOT/FAA/EE-85-8, "1985 Small Propeller-Driven Aircraft Noise Test Program", preliminary report, dated October 1985.

2. CAEP/1-WP/14, Working Paper, Presented by Mr. Hierl, Fed. Rep. of Germany, Mar 19, 1986.

3. CAEP/1-WP/20, Working Paper, Presented by Mr. Cowling, UK, Apr 17, 1986.

4. CAEP/1-WP/21, Working Paper, Presented by Mr. Cowling, UK, Apr 17, 1986.

5. CAEP/1-WP/23, Working Paper, Presented by Mr. Cowling, UK, Apr 17, 1986.

6. CAEP/1-WP/40, Working Paper, Presented by Mr. Wesler, USA, May 13, 1986.

7. CAEP/1-WP/45, Working Paper, Presented by Mr. Cowling, UK, May 21, 1986.

8. CAEP/1-WP/48, Working Paper, Presented by Mr. Smith, ICCAIA, May 21, 1986.

LPDA-TPP-007
Calibration & Tape Requirements
R G Hund
8/29/95

Applicable FAR: FAR 36, Appendix G, G36.105(f) and Appendix A, A36.3(e)

Applicable JAR: JAR 36, 5th Draft, Sept 1995, Section 1, Appendix 3, 4.4.2 and 4.4.3

1. Recommendation

Harmonization/Regulation change is not required.

2. Background & Relevant Data

The Joint Aviation Requirements, Part 36, and the Federal Aviation Requirements, Part 36, if a tape recorder is used, require the same verification of the frequency response of each electrical system and similar frequency response tests of each reel of magnetic tape.

The differences between the JAR and FAR requirements for magnetic tape testing are the minimum duration of the calibration tone and the 1/3 octave bands evaluated.

JAR - "Each reel of magnetic tape ... carry a calibration signal consisting of at least a 15 second burst"...
"the level difference in the 10 kHz 1/3 octave band filtered levels ... is not more than 0.75 dB."

FAR - "Each reel of magnetic tape ... carry a calibration signal consisting of at least a 15 second burst" ...
"the difference between each 1/3 octave band exceeds 0.75 dB."

3. Discussion

The JAR and FAR magnetic tape validation test requirements can be satisfied by conducting the tape evaluation to meet both regulations with a negligible difference in cost.

The JAR requires that the calibration signal duration is 30 seconds instead of a minimum of 15 seconds.

The FAR requires evaluation of each 1/3 octave band instead of just the 10 kHz band.

Recommendation is that no changes to the FAR or to the JAR are required for Harmonization.

Aviation Rulemaking Advisory Committee
FAR/JAR Harmonization Working Group
Propeller-Driven Small Airplanes

LPDA-TPP-008
Power Deviations Allowed
Carlos Latoni
July 17, 1995

Applicable FAR: FAR 36, Appendix G, G36.201(c)(2)

Applicable JAR: None

1. Recommendation

Add to the JAR, Section 1, Appendix 3, 5.2.1, the use of 5% power deviation for fixed pitch propeller as stated in FAR

2. Background & Relevant Data

The power/rpm variation on a fixed pitch propeller is affected by several factors, mainly aircraft pitch attitude, temperature and humidity. The rpm, which is directly related to power, is difficult to control during the climb out. The slight change in pitch attitude will result in an increase or decrease in rpm. It is, therefore, desirable to provide a tolerance to which no data correction is required for either power or propeller tip Mach Number. The JAR does not provide a tolerance to power deviations, where the FAR does for the reasons previously mentioned.

3. Discussion

The JAR 36, Section 1, Appendix 3, should be modified to incorporate the engine power and propeller tip mach number deviation as follows:

In 5.2.1(c)

Add item (a) The propeller is fixed pitch and the test power is within 5% of the reference.

In 5.2.1(d) add the following sentence:

5.2.1(d) ..... engine rpm. For fixed pitch propellers if the power is not within 5% of reference power. .....

Aviation Rulemaking Advisory Committee
FAR/JAR Harmonization Working Group
Propeller-Driven Small Airplanes

LPDA-TPP-009
Power Definitions
Carlos Latoni
July 18, 1995

Applicable FAR: FAR 36, Appendix G, G36.111(2)(iv)

Applicable JAR: JAR 36, Section 1, Sub-Part D, 36.340 (b)(2)(iv)

1. Recommendation

Replace JAR 36, Section 1, Sub-Part D, 36.340(b)(2)(iv) with FAR 36, Appendix G, G36.111 (2)(iv) wording for the 2nd phase (segment) of the take-off portion.

2. Background & Relevant Data

Not applicable

3. Discussion

The JAR 36, Section 1, Sub-Part D, 36.340 (b)(2)(iv) can be interpreted to allow the use of a power setting other than take-off power or maximum continuous power during the 2nd phase of the take-off. The FAR clearly states take-off or maximum continuous power, which is consistent with FAR 23. JAR 36 which reads as follows is not specific and allows the authority to allow the use of lower power settings even if the propeller is of a variable pitch type.

(iv) The maximum power and RPM that can be continuously delivered by the engine or engines in this flight condition shall be maintained throughout the second phase (unless a lower limiting power is established by the Authority).

LPDA-TPP-010
Mach Tolerance
John F Bertolacci
August 9, 1995

Applicable FAR: FAR 36, Appendix G, G36.201(c)(3).

Applicable JAR: JAR 36, 4th Draft, Dec 1993, Section 1, Appendix 3, 5.2.2 (c)

1. Recommendation

It is recommended that FAR 36, Appendix G, G36.201(c) be revised to add a sub-section (3) as follows:

No adjustments for helical tip mach number variation need be made if the propeller helical tip mach number is:

1. At or below 0.70 and the test helical tip Mach Number is within 0.014 of the reference helical tip Mach Number.

2. Above 0.70 and at or below 0.80 the test helical tip Mach Number is within 0.007 of the reference helical tip Mach Number.

3. Above 0.80 and the test helical tip Mach Number is within 0.005 of the reference helical tip Mach Number. For mechanical tachometers, if the helical tip Mach Number is above 0.8 and the test helical tip Mach Number is within 0.008 of the reference helical tip Mach Number.

2. Background & Relevant Data

JAR 36, 4th Draft, Dec 1993, Section 1, Appendix 3, 5.2.2(c) allows additional latitude when correcting for helical tip Mach Number. If the test helical tip Mach Number falls within a certain tolerance of the reference helical tip Mach Number then no correction is required. No tolerance is defined under the referenced FAR.

3. Discussion

Attachment 1 contains an analysis for nine US manufactured aircraft which represent a good cross section of US propeller driven aircraft. Reference 1 contains the actual K2 values for each aircraft as well as the reference helical tip Mach Numbers. The data was analyzed assuming the M_T was equal to M_R reduced by the maximum tolerance based on the reference M_R.

The resulting corrections ranged from 0.09 to 0.70 dB(A), with an average of 0.44 dB(A) for all the samples. All the values are well within the tolerance of a Type 1 sound level meter as defined by Table 5 in Reference 2.

Reference

1. FAA Report EE-83-1, "Noise Levels and Data Analyses for Small Prop-Driven Aircraft", dated August 1983.

2. IEC Publication 651, "Sound Level Meters"

TPP 10, Attachment 1

	TECHNICAL POSITION PAPER 10 WORK SHEET					
	LA=K2*LOG(MR/MT): JAR 5.2.2(c)					
No.	Aircraft	K2 (Ref 1)	MR (Ref 1)	MT (Note 1)	LA (K2-Ref 1)	LA (K2-150)
1	C-170	70.2	0.715	0.708	0.2999	0.6409
2	PA-38	75.8	0.67	0.656	0.6952	1.3756
3	PA-28	148.2	0.772	0.772	0.5810	0.588
4	C-180	126.6	0.827	0.819	0.5345	0.6332
5	B-58P	143.6	0.841	0.833	0.5961	0.6226
6	C-414	148.9	0.824	0.816	0.6309	0.6356
7	KA-200	53.7	0.786	0.786	0.2068	0.5776
8	PA-42	76.6	0.758	0.758	0.3058	0.5988
9	C-441	21.6	0.708	0.708	0.0923	0.6409
	AVE.=	96.1333		AVERAGE=	0.4380	
NOTES:						
1. MT = MR - .014; MR< .70; JAR 5.2.2 (c)(1): A/C No.2						
MT = MR - .007; MR< .70; JAR 5.2.2 (c)(1): A/C No.1, 3, 7, 8 & 9						
MT = MR - .005; MR< .80; JAR 5.2.2 (c)(3)						
MT = MR - .008; MR< .80; JAR 5.2.2 (c)(3) with mechanical tachometers A/C No. 4, 5 & 6						
2. Ref 1 = FAA REPORT EE-83-1, "NOISE LEVELS AND DATA ANALYSES FOR						
SMALL PROP-DRIVEN AIRCRAFT", TABLES 10.1 AND 17.3						

Aviation Rulemaking Advisory Committee
FAR/JAR Harmonization Working Group
Propeller-Driven Small Airplanes

LPDA-TPP-011
Slow "A" Weighting
R G Hund
8/31/95

Applicable FAR: FAR 36, Appendix G, G36.105(e)

Applicable JAR: JAR 36, Section 1, Appendix 3,3 Noise Unit Definitions; JAR 36, Section 1, Appendix 3, 4.3 Sensing Recorking and Reproducing Equipment.

1. Recommendation

No harmonization recommended.

2. Background & Relevant Data

Both bodies of regulation require the subject meter setting. The wording differs between FAR and JAR.

3. Discussion

Even though the wording differs between the bodies of regulation, the intrepretation is the same.

LPDA-TPP-012
Items Not Harmonized
R L Howes and R Wilson
10/11/95

Applicable FAR: See text

Applicable JAR: See text

In Document 2a, Items 1, 4, 5, 7 and 11 were not recommended for harmonization. It was concluded that harmonization was not required for the following reasons:

Item 1: Applicability

The applicability dates listed have all lapsed making this issue moot.

Items 4 and 5: Tape Recording, Calibration and Quality

See LPDA-TPP-007

Item 7: Pre/De-Emphasis Recording

No harmonization is recommended here. The standards that describe the requirements for this type of equipment are in the process of being updated to take into account the technological benifits of newer digital instruments and data processing equipment.

Item 11: Reference Noise Level

This is already harmonized. The only difference is that JAR 36 summarizes the corrections to be applied in the form of an equation and FAR 36 simply states the requirement.

General -

There are instances in which certain numerical rounding differences cause values to deviate by a small amount between the bodies of regulation. These differences are not considered significant enough to warrant the efforts required to harmonize them, eg. FAR 36, Appendix G, G36.101(b)(2) specifies the lower test temperature limit as 2.2 deg C and JAR 36, 4th Draft, Dec 1993, Section 1, Appendix 3, 2.2.2(b) calls out 2 deg C.